The Northwestern MILLER
MILLING PRODUCTION SECTION

Fig. 1.—Grain cannot be stored safely in a granary that is in a poor state of repair.

Fig. 2.—A good four bin farm granary with drive between the bins is illustrated above.

Fig. 3.—A good type of farm elevator which provides facilities for moving the grain.

Farm Storage of Cereal Grains

By H. H. Walkden
Bureau of Entomology and Plant Quarantine
U.S. Department of Agriculture

IN storing grain, the ideal is to have its condition at the end of storage as good as it was at the beginning. Man has been aiming at this ideal ever since he has been using cereals as food for himself and his animals, but as yet without attaining it. However, great advances have been made in the past few years. Better storage structures and improved methods of insect and rodent control have greatly reduced the losses to grain while in storage.

Losses to farm-stored grain are due chiefly to faulty storage structures (See Fig. 1) and unsuitable condition of the grain when put into storage. Grain that is put into proper farm storage in a dry condition (below 12% moisture content) can be safely stored indefinitely if certain precautions are taken during the storage period. In the central and southern sections of the Great Plains, where a large part of the hard red winter wheat crop is grown, the problem of preventing insect infestation of the grain in storage is aggravated by higher average temperatures than prevail in more northern wheat-growing sections of the U.S. and Canada.

Amount of Storage Losses

Throughout the world losses to stored grain due to insects, rodents and mold fungi have been estimated at 10% of the total annual production. Although such losses are not so high in the U.S., these destructive agents exact a considerable toll each year. Observations made by the Bureau of Entomology and Plant Quarantine in south-central Kansas during the period 1945-50 showed that during the first five months of storage the average insect damage to wheat in untreated farm bins was slightly more than 3%, and in one bin it amounted to 14%.

Observations were also made by the bureau on the cost of insect infestation in farm-stored wheat in south-central Kansas. The results in four bins where the wheat was weighed into and out of storage are given in Table 1.

Cost of Insect Infestation in Farm-Stored Wheat After Five Months of Storage

Original test weight	Original grade	Insect damage	Test weight delivered	Grade delivered	Discount per bu.*
lb. per bu.		%	lb. per bu.		cents
60	1 HW	3	58	2 HW	1
58	2 HW	3	56	3 HW	2
58	2 HW	10	52	4 HW, weevily	6–10
58	2 HW	14	50	Sample HW, musty, weevily	20-30

*Based on No. 1 hard winter wheat at $1.96 per bu.

By fumigation of the grain at the proper time such losses could have been avoided and the buyer assured of high quality insect-free wheat with resultant low insect fragment count in flour milled from it. Most wheat growers are not aware of the amount of shinkage due to insect damage during farm storage, because they do not weigh the wheat at the time it is stored.

Further evidence of excessive losses due to insects is found in data on the condition of wheat arriving at a large grain terminal in Kansas, obtained from records of the Kansas State Grain Inspection Department. These are given below:

Month, 1949—	No. of cars received	% of cars graded weevily
February	2,308	15
October	1,182	21
December	2,032	17

Under the provisions of the U.S. grain standards for wheat, the adjective "weevily" is added to the grade designation if a 1,000-gram sample contains two or more live weevils, five or more live bran beetles, or one live weevil and three or more bran beetles. Obviously, much wheat may be infested with insects but not have sufficient numbers to warrant a grade of "weevily."

How Insects Damage Stored Grain

Insects destroy stored grain by feeding in it, but their mere presence in large numbers may cause more serious damage. When insects become concentrated in farm-stored grain, the heat and moisture created by their body processes develop hot, moist spots in the grain. When cool weather comes in the fall, the water vapor rising from these spots condenses in the cooler surface grain, and causes it to rot, mold or sprout. Although the damage does not usually extend more than two feet below the surface, the entire grain mass is contaminated with the musty or rotten surface grain when the bin is emptied, so that it is graded as "sample, musty," and must be offered for sale at a discount.

The temperature and moisture of grain in infested and uninfested steel bins from Nov. 1 to April 2 are shown in Fig 5. The wheat in the infested bins was graded "sample" on Nov. 1 and by the end of the storage period, April 2, portions of it in the south quadrant showed insect damage of 40%, and average samples of the entire grain mass were graded "sample, weevily, musty."

Kinds of Insects Found in Farm-stored Grain

The six-year study in south-central Kansas showed that 14 species of insects occur in farm-stored grain. Three of the species, however, constituted more than 75% of the total population. The relative abundance of the various species during July, August and September of each year is given in table 2. The saw-toothed grain beetle and the flat grain beetle occurred in greatest abundance during the period, with the cadelle ranking third. The weevil group, consisting of the rice weevil, granary weevil and lesser grain borer, constituted 4% of the total population in July, 8% in August and 9% in September.

Factors Influencing Insect Abundance

Grain that is [illegible] dry and free from dust and broken kernels is unfavorable for the development of insects. Bran beetles, including the red flour beetle and the saw-toothed grain beetle, do not lay eggs at 60° F. or below. Neither do they breed in clean grain unless the moisture content is 11% or higher or the temperature is at least 80° F. However, if the grain contains floury dust or broken kernels and the temperature is 70° F. or high-

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er, they will breed in it regardless of moisture content.

The rice weevil and the granary weevil breed freely in clean grain, but require a temperature of 60° F. or higher for rapid multiplication. The lesser grain borer requires a somewhat higher temperature for reproduction. Neither of the weevils can live or breed in grain of a moisture content below 9%, and there is little breeding below 11% unless the temperature is 85° F. or higher. The lesser grain borer is able to develop in grain containing less moisture than that required by the weevils.

Sources of Infestation

The rapidity with which infestation develops in farm-stored grain leads many people to believe that insects are generated "spontaneously," or that the infestation is brought in from the field. A recent study by the writer* indicated that field infestation seldom, if ever, occurs in south-central Kansas. However, farther south field infestation by certain species is common. Insects are present in farm granaries most of the time and can migrate readily into grain when it is put into storage. The cadelle bores into the woodwork of farm granaries, and other species hide in the burrows made by the cadelle (Fig. 6). Stored-grain insects may be harbored in the following places on the farm:

(1) Accumulations of waste grain in and under granaries, and waste grain and litter in driveways between bins.
(2) Bagged feed stored in or near granaries.
(3) Railway boxcars sold by railroads to farmers for use as granaries.
(4) Poultry houses, strawstacks and feed barns.

The enormous reproduction potential of insects under favorable conditions accounts for their sudden appearance in hordes. Some idea of the breeding rate of the rice weevil can be gained from the following computation, assuming an abundance of food, ideal temperature and moisture conditions, and that no mortality occurred during the period. Start with two weevils, one of which is a female laying 300 eggs.

First brood.....	300
Second brood.....	45,000
Third brood.....	6,750,000
Fourth brood.....	1,012,500,000
Fifth brood.....	151,875,000,000

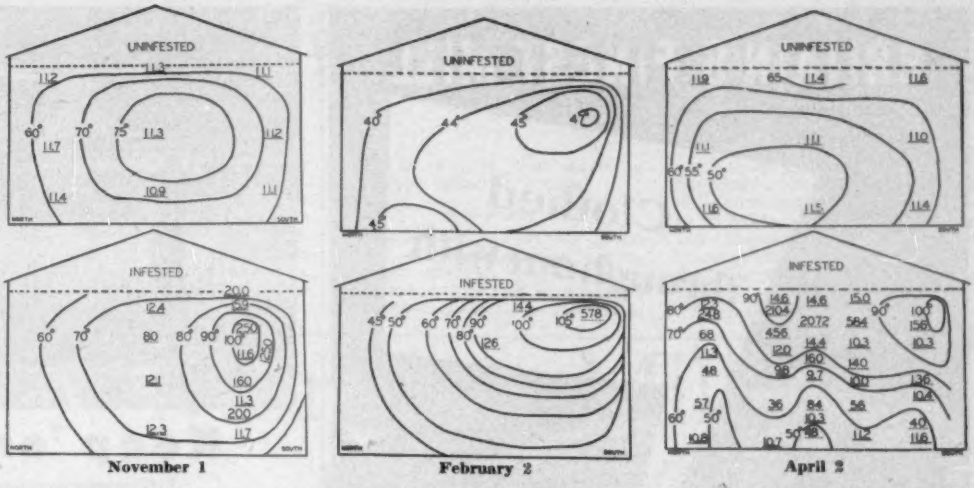
The total is 152,894,295,300 weevils in five broods in approximately six months.

From these astronomical figures sudden appearances of huge numbers of insects in stored grain can readily be understood.

Effect of Moisture Content of Grain on Insect Infestation

In south-central Kansas the moisture content of farm-stored grain varies from year to year, depending largely upon harvest time conditions. Observations in farm-stored wheat during the period 1946-50 showed that most of it went into storage at a moisture content of 11 to 12.9%, and that there was little change during the storage period. The range and percentage of moisture and the insect population in September are shown in Fig. 7. Insect populations were greatest in 1947 and 1949, when the

(Continued on page 19a)



Note the high-moisture area over the hot spot near the south side of the infested bin.

Note spread of high temperature into center of infested bin, and low temperature in uninfested bin.

In the infested bin the entire grain mass is now heavily infested and the surface caked and moldy.

Fig. 5.—Comparison of temperature and moisture content of wheat in uninfested and infested 1,000-bushel circular steel bins from Nov. 1 to April 2. Figures underscored with solid lines are percent moisture, those underscored with broken lines are number of insects per 1,000 grams of grain.

*Walkden, H. H.—Field Infestation of Ripening Wheat by Stored-Grain Insects. The Northwestern Miller, Milling Production Section, 16(3):7.

Fig. 4.—Galvanized steel bins provide excellent storage provided all joints are tightly caulked.

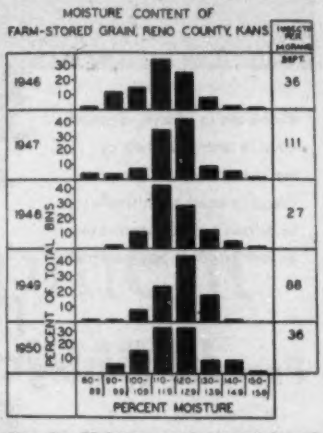


Fig. 7.—Moisture content and insect populations in farm-stored grain in September, Reno County, Kansas, 1946-50.

Table 2—Comparative Abundance of Various Insects Found in Farm-Stored Grain During July, August and September, Reno County, Kansas, 1945-50

Species—	Per cent of total insects observed						
	1945	1946	1947	1948	1949	1950	Mean
BRAN BEETLES—July:							
Saw-toothed grain beetle	48	62	53	41	22	77	47
Flat grain beetle	45	17	24	27	40	2	27
Cadelle	**	13	5	10	9	2	7
Hairy fungus beetle	1	1	4	2	4	**	4
Small-eyed flour beetle	0	2	3	5	4	2	4
Red flour beetle	3	3	4	**	13	0	4
Indian-meal moth	0	0	1	3	0	9	2
Foreign grain beetle	0	0	0	1	1	2	1
Dermestids (species not determined)	**	**	**	**	**	1	**
Long-headed flour beetle	1	0	0	0	0	0	**
WEEVILS—July:							
Granary weevil	0	1	4	1	2	4	2
Rice weevil	0	**	1	3	1	0	1
Lesser grain borer*	2	**	1	1	**	0	1
BRAN BEETLES—August:							
Saw-toothed grain beetle	26	38	51	14	21	35	31
Flat grain beetle	53	14	16	24	28	6	23
Cadelle	**	30	16	33	36	28	23
Red flour beetle	2	12	3	2	7	**	4
Indian-meal moth	**	**	2	2	4	10	3
Small-eyed flour beetle	0	1	1	4	2	2	2
Hairy fungus beetle	**	**	1	3	3	4	3
Foreign grain beetle	0	**	**	5	**	4	2
Long-headed flour beetle	8	**	**	0	0	0	1
Dermestids (species not determined)	**	**	1	1	**	**	1
Yellow mealworm	0	0	**	**	0	0	**
WEEVILS—August:							
Lesser grain borer	12	1	3	8	**	0	5
Granary weevil	0	1	6	1	1	2	2
Rice weevil	**	**	1	3	**	0	1
BRAN BEETLES—September:							
Flat grain beetle	39	57	33	35	42	52	42
Saw-toothed grain beetle	27	11	30	10	18	17	19
Cadelle	**	15	14	29	20	10	15
Foreign grain beetle	0	2	2	10	**	7	4
Small-eyed flour beetle	0	**	7	4	5	4	3
Red flour beetle	2	8	1	3	**	**	3
Long-headed flour beetle	12	1	0	**	0	**	2
Hairy fungus beetle	**	**	2	1	3	1	1
Indian-meal moth	**	1	1	1	1	2	1
Dermestids (species not determined)	**	**	**	**	**	1	**
Yellow mealworm	0	1	0	0	0	0	**
WEEVILS—September:							
Lesser grain borer	20	3	2	3	**	1	5
Granary weevil	0	1	4	3	5	3	2
Rice weevil	**	**	5	2	**	4	2

*Although not a weevil, this borer causes damage similar to that of the weevils.
**Trace (less than 1%).

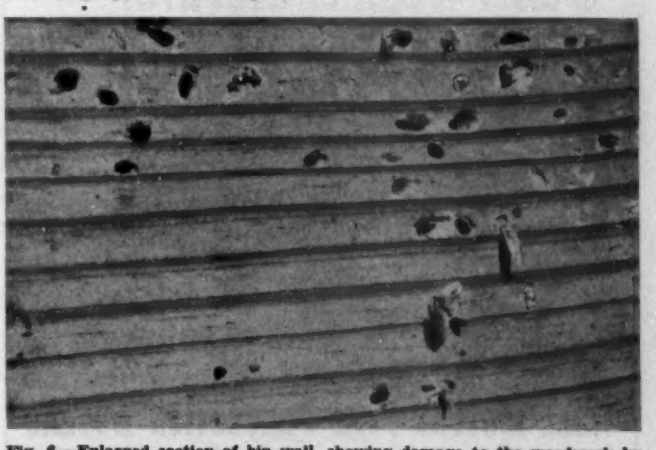


Fig. 6.—Enlarged section of bin wall, showing damage to the woodwork by the cadelle. Other stored-grain insects also hidden in these burrows, and when the bin is filled with the new crop grain, they come out and infest it.

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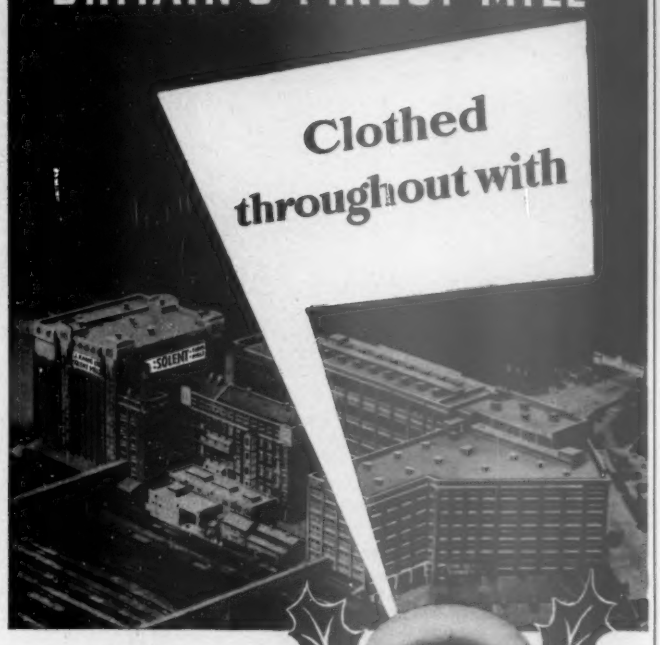

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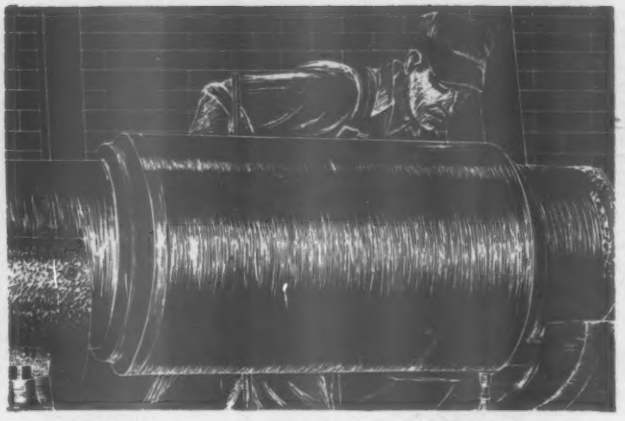

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Reduce the Fire Hazard in Your Plant

By P. C. Hensler
Fire Protection Institute

THE distinguishing characteristic of American industry is its constant striving for production efficiency. Protection against fire, on the other hand, is too often given only minor consideration. In this attitude of complacency lies great danger—for neglect of fire safety can render all other improvements useless.

Industrial fire losses have increased about 68% in the past 10 years, approximating $175 million or about one quarter of the total fire loss for 1949.

Twenty-three hundred mills throughout the nation felt the ravages of fire last year with property damage totalling $26 million. Mill operators who have seen production crippled by destructive blazes know the seriousness of lost man-hours, damaged equipment and fire-charred stock. Even a minor fire can disrupt smooth-flowing production.

The alarming number of fires occurring in mills throughout the country each year indicates that, while many mill operators and employees may be aware of the existence of fire safety measures, some seem to have forgot to put these measures into daily practice. Fire safety experts believe the current annual fire loss in mills across the nation can be reduced substantially through better trained plant personnel and increased know-how in the use of dependable Underwriters'-approved fire protection equipment, such as fire extinguishers.

Modern mills of large capacity are, with few exceptions, of fire-resistive construction with walls, floors and roofs of brick and concrete. Despite up-to-date construction, a dangerous hazard exists in all mills—dust explosion.

In its "Code for the Prevention of Dust Explosions in Flour and Feed Mills," the National Fire Protection Assn. has set forth certain recommendations which can help lessen the chances of fire from this hazard.

Structural Features

The processes of milling require heavy construction and dependence for venting explosion must be placed on large window areas. Glass should be no thicker than necessary and wired glass should be used only where necessary as a protection against exposure. Windows should be arranged to provide maximum ventilation when open.

Cupolas, galleries and those sections of grain storage not requiring strength should be of as light construction as is practicable. All interior surfaces, including the inside of bins and garners, should be as smooth as practicable. Horizontal surfaces inaccessible to cleaning and all pockets and ledges should be minimized, where possible.

As great a space as is practicable should be provided between the storage sections and the mill. At the points where belt conveyor galleries or tunnels are connected to the main buildings, tight incumbustible partitions can be provided. Belt openings in the partitions should be as small as possible and door openings can be protected by self-closing fire doors.

Grain bins and tanks can be equipped with dust-tight covers or decks. If the bins are covered, the bin floor should be as watertight as possible to prevent water damage to grain in the event of explosion or fire. Bin floors should be scuppered. Roofs of grain storage units, cupolas and galleries can be provided with monitors or other ventilators which, in conjunction with windows, will provide frequent changes of air. Each bin or tank itself should be separately vented to outside.

Equipment

Elevator legs, heads and boots should be so constructed as to minimize the possibility of chokes. Hand holes can be provided at head and boots for convenience in the inspection of belts and pulleys. Where grain is delivered to boot by conveyor belt, the latter can be equipped with an automatic mechanical or electrical device that will stop the belt or notify the operator when the leg chokes or slows down.

All cleaning or other grain processing machinery can be of incombustible construction. When wooden machines are used, such machines can be metal clad. All clippers, smutters and scourers can be equipped with a screen to exclude all matter of larger size than the grain treated by the machine.

If a magnetic or pneumatic separa-

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DATING BACK to the year 1000 B.C., a grinding mill of this type is described in Homer's Odyssey. This celebrated author tells of female slaves turning the toilsome mills to produce "pure" flour for the growth and strength of man. The two stones were very heavy and about two feet in diameter. Grain was poured into an opening in the upper stone. Rotation was by means of a stick fixed into the edge of this stone. Although almost 3000 years old, this method of milling was *still* used by the natives of Morocco in the early part of this century.

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But just as Morocco natives clung to ancient grinding methods, so do many millers today stick with outmoded, inefficient milling equipment purchased many, many years ago. Actually this obsolete machinery *loses* money every day it operates. Plant capacity is held to a minimum and maintenance costs keep steadily mounting.

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tor is used, place it as near as practicable to the place it is intended to protect. Pneumatic separators can be so designed that all foreign materials will be removed from the grain being ground. Provisions can be made for the removal of such accumulated foreign matter from the separator.

Grain Driers

Driers can be placed in a separate fire-resistive division, separated from elevator or tanks by as much space as possible. The garner, hopper or bin over the drier should be dust-tight and provided with adequate ventilation or effective ducts to the outside. Fire-heated driers can be provided with reliable automatic means for regulating temperatures. Where temperature controls are operated by air pressure, suitable means should be provided to stop the drier fans automatically in case of air failure caused by leakage or broken air lines.

"Good housekeeping" and clean premises are essential in eliminating the dust explosion hazard. Dust on floors and other surfaces can be removed daily by sweepers. As many sweepers can be employed as are necessary to keeping the building clean. Push brooms of hair and soft fiber are recommended as they will throw less dust into the air and are easily adapted to sweeping under belts and other machinery.

Fire Protection

Despite all fire prevention precautions, mill fires still occur. With trained employees on the scene when trouble breaks out, much can be done to safeguard your mill from excessive damage. Many mill operators throughout the country are organizing employee brigades within their own ranks in an attempt to cut the number of damaging blazes. Brigade members are taught to recognize fire hazards and how to cope with them in the quickest and most efficient manner. They are familiar with the proper use and care of all fire-fighting equipment on the premises.

In organizing a plant fire brigade, it should be one man's duty to notify the local fire department immediately and to station himself at the entrance to the plant and act as a guide for the fire-fighting equipment which is sent from the fire station.

Under no circumstances should the call to the fire department be delayed. In too many instances the plant employees have thought that they could control the blaze only to have it get beyond their control. It is then too late because by the time the fire department arrives, the blaze may be beyond their control also.

The proper procedure is to notify the fire department immediately and then attempt to control the blaze until the firemen arrive. The fire department chief would much rather find that his services were not needed, than to find that the firemen got there too late.

The chief of the fire department and some of the key men under him should also be familiarized with the physical layout of the plant and probably supplied with maps showing the locations of the fire hydrants, entrances, places which fires are most likely to break out, etc.

The time to learn how to use such life-saving weapons as approved fire extinguishers is before a fire breaks out. For the sake of more effective fire-fighting, fires have been classified according to the source in which they burn and the type of approved extinguisher best suited for battling such a blaze.

Class A fires include wood, paper, cloth, rubbish and other combustible materials. Use approved foam or soda acid or water-type extinguishers.

Class B fires include oil, grease, paint and related products. Use approved foam, dry chemical, vaporizing liquid, carbon dioxide. (Do not throw water on this type of fire as water only spreads the flames.)

Class C fires include electrical installations, including motors and generators. Use approved carbon dioxide, dry chemical, vaporizing liquid extinguishers. **(Do not use "water type" extinguishers on electrical fires.)**

Remember that your surest defense against fire is preparedness. The time, effort and money involved in combatting the dust explosion hazard and maintaining a continuing fire prevention and protection program in your mill will pay its own rewards in keeping your mill off this year's fire loss lists.

—BREAD IS THE STAFF OF LIFE—

HOUSTON PORT EXPANSION

HOUSTON—The Houston Navigation District has announced plans to spend more than a million dollars from port earnings to buy 840 acres in three tracts of land in the ship channel area which port commissioners consider vital to the long-range development of the Port of Houston. One of the tracts being purchased is a 15-acre plot north of the public grain elevator, which will allow the port to develop a rail car classification and storage area adjacent to the public grain elevator and round out present facilities of the port terminal railroad.

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A Sanitation Program for Grain Dealers

By Glen R. Romig

ALL grain dealers realize the necessity of sanitation, but there has been very little actual clean up done by some, while others have really started a very good program. Some still think it is impossible to keep grain storage clean, as every time grain is moved there are accumulations of dust. But storage can be kept clean with a little effort and some improvements. With suction applied to the elevator legs and dust collectors installed there will not be so much dust in the air. Once the dust is controlled it will be much easier to keep the storage space clean. This will also reduce the insect breeding places. The effectiveness can only be accomplished by a constant and well planned sanitation program, and will pay dividends by the reduction in losses from insects and rodent damage.

This can be accomplished by a five-point program consisting of: (1) General clean-up inside and outside of buildings. (2) Repair of buildings. (3) Rodent control and rodent proofing. (4) Regular inspection of stored grain. (5) Planned general fumigation.

General Clean-Up Program

The appearance can be improved by cleaning up the most conspicuous places, but will be of very little value in reducing infestation. Some of the worst infested and unsanitary places are found in the out-of-the-way places, where it is least noticeable and inconvenient to get at, such as dark, damp elevator pits. The pit is usually small and very poorly constructed, especially so under old elevators. The lighting usually consists of a drop cord. Some are very inconvenient and hard to clean, other places are under flat houses where there is no light and the ventilation is poor. It is also very hard to get under these places, yet this is an excellent insect and rodent harborage. Usually there is some leakage of grain and this makes the food supply abundant. This grain also becomes infested with all kinds of insects, even if the bins are cleaned up before refilling with new grain. With such conditions existing right underneath, the new grain will soon become infested and the whole bin damaged in a very short time if temperature and moisture contents are favorable.

Therefore, it is necessary to keep the entire premises clean from the top of the buildings to the ground underneath. The outside area around the buildings should be kept clean and free of rubbish. Grain doors should be kept in a neat pile, at least eight inches above the ground, to prevent rodents from using them as a harborage. If the outside area around the buildings is kept clean and free of spilled grain it will not be attractive to rodents, and there will not be breeding places for insects around the foundations. Keeping the premises clean is also good fire protection.

Buildings should be kept in good repair at all times. Leaky roofs may cause considerable damage by spoiling grain. Also, this may be the cause of serious infestation as insects multiply very rapidly in moist, moldy grain that is heating. Therefore, one leak in the roof may be the cause of serious damage. Windows should be kept in good repair and kept closed or screened to keep the birds out so they will not roost over the bins of stored grain. Very often cars of wheat received have considerable quantities of bird excreta and feathers. Keeping elevators in good repair prevents loss and damage, also improves the value of the property.

Rodent Control Campaign

The control of rodents in and around grain storage is very important. Rodents consume and damage several bushels per rat of grain each

A. E. BAXTER ENGINEERING CO.
Designers and Engineers for Mills, Elevators and Feed Mills
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AERO* LIQUID HCN,
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After proper aeration, LIQUID HCN leaves no taste or odor, and does not affect the baking qualities of flour.

Call in your Industrial Fumigation Engineer to apply LIQUID HCN next time a plant-wide clean-up is scheduled . . . or write us for the name of such an expert serving your locality.

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- A hundred-pound bag of yeast food was recovered. When opened, the contents were found to be **bone-dry and lump-free.** The Bagpak Multiwall Paper had prevented the water from reaching the contents . . . **held it back** so it could do no damage.
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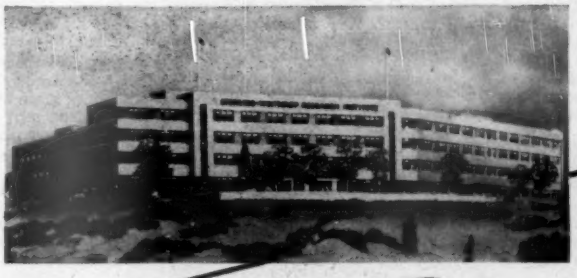

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FIRST — LIGNIN VANILLIN MADE IN UNITED STATES!

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Distributor of the products formerly sold by Special-Markets-Industrial Division of Winthrop-Stearns Inc., and Vanillin Division of General Drug Company.

year. The rat is considered public enemy No. 1 among animal pests. Besides consuming and damaging grain the rodent is very filthy as it travels through grain spreading excreta, hairs and often carrying disease. Once grain becomes contaminated by rodents it is very difficult to remove all of the filth from the kernels. Considering the damage done, it is much cheaper to finance a rodent control program than to feed and stand the damage done each year.

At the present time there are several poisons for the pest control operator and two for the general public. These are Warfarin (or compound No. 42), and red squill. Warfarin is both a rat and mouse poison. Very good results can be obtained when properly used. Also trapping is very effective in places where poison cannot be used. However, it must be remembered at all times that any poison is dangerous unless properly handled.

Rodent proofing must be done to accomplish an effective rodent control program. All holes where rodents can enter should be repaired. Scraps of tin can be used for this purpose. It is much easier to keep rodents out than it is to get them out once they are allowed to enter at will. Buildings close to the ground without a concrete foundation offer ideal protection for rodents. It is much better to have it open underneath than to have a poorly constructed board wall between the floor and the ground. Small mesh wire deeply anchored in the ground is good protection as it lets the light in. Rodents like to be in the dark where they are not molested and, if allowed such harborage, will multiply very rapidly.

Inspect Stored Grain Regularly

Stored grain should be inspected at regular intervals. This inspection should include examination of the grain for any sign of insects, or increase in the temperature of the grain. After grain has gone through the first heat stage (commonly known as sweat) any additional heating is not normal and is caused either by outside moisture from bad roofs, or from infestation. If this condition is not corrected immediately serious damage will occur. If such condition is caused by infestation, correction can be made by fumigation and then turning and cleaning the grain.

A leak in the roof will also cause mold damage to a considerable amount of grain in the bin. This mold, if abundant, will cause the grain to sell at a lower grade. Therefore, it is very important to keep storage buildings in the best of condition, free from rodents and infestation.

Planned General Fumigation

Planned general fumigation is considered essential if infestation is to be controlled. Best results can be obtained when the storage bins are as near empty as possible. All grain held over from one year to the next should be fumigated with a good grain fumigant at the same time the general fumigation is done. If there is not a fumigator regularly employed, commercial fumigators can be called in and the complete fumigation planned and arranged for. Between fumigations spraying is very helpful in controlling insects. Very good results can be obtained by spraying empty bins with a good residual spray.

If this program is carried out the infestation will be kept to a minimum and the grain will be delivered without the grade certificate carrying a notation (weevil), which constitutes a lower grade and a lower price per bushel.

Cleaning of box cars is very often badly neglected. Cars of wheat have been received containing various kinds of objectionable refuse on the floor which was not cleaned out before the wheat was loaded. Also, in this time of car shortage all kinds of cars are loaded. Some are very badly broken and have to be patched up before they will hold grain, but all cars can be patched, fumigated and cleaned before loading. About 90% of the wheat marketed is used for human food, so let us protect and care for the raw material as we would the food for our tables.

—BREAD IS THE STAFF OF LIFE—

"Largest Ready-To-Eat-Cereal Company in the World"

Modernizes with DAY
DUST CONTROL—MATERIAL HANDLING

From a small one-room corn flakes plant, operated by W. K. Kellogg, soon after the turn of the century, has sprung the Kellogg world wide ready-to-eat-cereal enterprise with plants in Battle Creek, Michigan; Omaha, Nebraska; Canada; Great Britain; Australia; South Africa, and Mexico. Today, the Kellogg Company manufactures nearly a dozen different ready-to-eat-cereals, and in addition, dog, poultry and stock feeds. Kellogg products are known and distributed throughout the world, and the company has become known as the "Largest Ready-To-Eat-Cereal Company in the World."

In a recent modernization program at Kellogg's large Battle Creek, Michigan plant the DAY Company was selected to engineer, manufacture and install dust control, material handling and storage equipment. The total project included the following:

DUST CONTROL FOR CORN AND WHEAT CLEANING: A turn-key job which included self-cleaning DAY Type "AC" Dust Filters with proven dust collection efficiencies of 99.99% and better; the widely accepted DAY Dual Clone Dust Separators which assure maximum centrifugal dust separation, and DAY Exhausters designed for highest efficiency in dust control applications.

MATERIAL HANDLING: DAY self-cleaning Pneumatic Conveyor system was installed for fast, dust-free grits conveying.

CEREAL STORAGE: For use in the storage of Rice Krispies, DAY fire and vermin proof, non-bridging bulk storage bins were supplied. These bins are furnished in either heavy, galvanized black iron or stainless steel.

LEADING COMPANIES RELY ON DAY

Records show that most of the nation's leading millers and many food processors depend upon DAY. According to a national survey, DAY dust control equipment is the predominant choice, with DAY leading its nearest competitor in this field of dust control by a margin of 10 to 1.

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This achievement record, plus the experience gained by The DAY Company in engineering, manufacturing and installing dust control systems for mills, elevators, food plants since 1881 is of great importance to you. It means that when you call upon DAY, you benefit from their 70 years' experience. No other dust control manufacturer can even approach DAY's accumulated knowledge in this specialized field. Regardless of your dust problem, DAY can provide an effective and economical solution. For engineering assistance and cost estimates, Write-to-DAY!

DAY SINCE 1881

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Branch plants in Fort Worth, Buffalo and Welland, Ontario.

Sweden's Milling Industry

TOGETHER with the industrialization of Europe, which became general during the last decade of the 19th century, industry in Sweden made great progress, and not least the flour milling industry. In consequence of a sharp increase in population and the relatively larger needs of wheat flour, home production of grain was not sufficient and imports became necessary. These imports soon encouraged the erection of commercial mills in many parts of the country. They were built in or near the ports in order to avoid long haulage of the grain.

The cultivation of bread grain in Sweden during the last six years of the decade under review was featured by a shift in the acreage un-

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Dramatic shows and timely spots on ready-to-use transcriptions—specially prepared for the use of millers in their own advertising

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Above: FREDRIC MARCH—Famous star of stage and screen.

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Right: DANE CLARK—Well-known motion-picture star.

It would be difficult to name four more popular guest stars to feature on your radio program than Margaret O'Brien—Fredric March—Deborah Kerr—Dane Clark. Usually, you would have to pay a high fee for their services. But the Merck Library of Radio Transcriptions on Enrichment brings them to you *without charge*, on a nonexclusive basis. This Library is exceptionally complete. It includes—on ready-to-use records—a 15-minute dramatic show—5-minute documentary segments—3-minute segments—and 20-second to 1-minute spots. In addition, it contains scripts on Enrichment for all types of live shows. No matter what kind of radio program you sponsor, you will find a wealth of material from which to choose.

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Our illustrated 12-page brochure *Cavalcade of Enrichment* describes every record in the Merck Library of Radio Transcriptions. It also contains practical suggestions on publicity, point-of-sale material, and other ways of enhancing the prestige of your company in connection with the 10th Anniversary of Enrichment.

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der wheat and rye. In that period the wheat area showed a four-fold increase, whereas the rye area declined by one half but the total area under bread grain increased by about 10%. However, better cultivation of the soil and careful choice of seed for the different crop growing districts produced in the course of time considerably higher yields per acre, particularly of wheat. On this account farmers switched more to wheat at the expense of rye. The considerable change in wheat cultivation is illustrated by the fact that at the beginning of the 1940's, 30 to 40% of the entire wheat acreage consisted of spring wheat.

Whereas the commercial mills were earlier obliged to cover a great part of their wheat requirements by imports, the country has become, in the last 10 years, largely self-supporting. Nevertheless, a certain amount of grain has continued to be imported, partly for strengthening the supply position and partly to satisfy consumers' wishes for a particularly good baking flour. Imports of flour today are of no significance.

By far the largest part of grain milling in Sweden is carried on by the commercial mills, whereas the toll mills are of little importance. The commercial mills account for 93% of the production of wheat flour and 90% of rye flour. The toll mills concentrate mainly on provender milling.

Industrial statistics for the year 1944 show that there were then 1,400 commercial and toll mills in the country and they employed nearly 4,000 workers. The number of commercial mills totaled 180, with a personnel of 2,000. The capital value of these mills was given in the same year as 200 million kronnen.

There are about 30 large mills in Sweden and the daily capacity of the largest does not exceed 100 tons. There are few medium-sized mills. Small mills are worked predominantly by stones.

In addition to the flour and rye milling industry, there is a special industry for oat groats, which was developed at the end of the last century. Macaroni in large quantity is also produced in some large mills as well as in special factories.

Sweden imported in the years 1939, 1949, and 1950 her mill machinery mainly from Germany, although British manufactures are used on a fairly wide scale. As is generally known, the very high price of British machines on the Scandinavian markets, owing to the exchange rates at that time, caused them to become less competitive with other foreign machines and particularly those of German manufacture.—**Die Muhle.**

—BREAD IS THE STAFF OF LIFE—

Commercial Feed Sales in Texas Hit Record Total

COLLEGE STATION, TEXAS—A record tonnage of commercial feeds was sold in Texas during the past fiscal year, according to F. D. Brock, director of the Feed Control Service, Texas Agricultural Experiment Station.

From Sept. 1, 1950, to Aug. 31, 1951, an estimated 3,853,600 tons of feed were sold in Texas. This was an increase of 617,250 tons over 1949-50 and 525,600 tons more than was sold in 1942-43, the previous record year.

Although the exact tonnages sold for the various classes of livestock, poultry and so forth are not known, Mr. Brock said indications are that the largest increase occurred in the use of range feeds.

There are 888 active commercial feed firms doing business in Texas, 217 of which are located outside the state. These firms sell thousands of different feed formulations. Several have registrations covering as many as 150 different products each.

These figures do not include farmers who are exempt under the law. Although farmers may process feed they grow, they are not required to register or tag it.

During 1950-51 the Feed Control Service sold 87 million feed tags—each tag issued for an amount ranging from 5 to 125 lb. of feed.

Mr. Brock said he expects the tonnage of feed sold in Texas to decrease sharply during 1951-52 because of the large numbers of cattle now going to market. Sales of feed for poultry and swine probably will increase, he said.

—BREAD IS THE STAFF OF LIFE—

NEW ADDRESS

COLUMBUS, OHIO—Vaughn M. Thorne, executive secretary of the Ohio Grain, Mill & Feed Dealers Assn., announces that the offices of the association have been moved to a new location at 1314 Kinnear Road, Columbus 12. Visitors will find ample parking space, Mr. Vaughn reports. All correspondence should be addressed to the new address.

1. A&S Research has led the field in bag design and production for 90 years.
A&S RESEARCH
BETTER BAGS because...
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THE OLDEST NAME IN PAPER BAGS
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2. Highest quality printing that really stands out.
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A&S MODERN DESIGN

Expendable Pallets—Palletized shipments of A&S bags lower your handling costs, minimize storage space.

STA-STAK Bag—Creped outer wall takes skid and slip out of stacking. Greater resiliency, easier handling.

SHUR-CLOSE—Ingenious bag valve assures less dust when packing—less sifting when packed—prevents waste.

PLASTO-PAK Bags—Polyethylene lined, moisture-proof protection for hygroscopic materials.

SUPER GLOSS Flour Bag—Toughest of flour bags is bright white with brilliant inks to provide sparkling, appealing shelf packages.

ARK-TONE Printing—Sharp, clear color process combines perfect reproduction and brightness for consumer packages.

HI-TONE Printing—Strong, deep colors for sugar, salt, rice and similar bags.

PRESSUR-PAK Bale—Bags are packed under pressure. Saves 50% of customers' space allotted to storage.

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Kansas Wheat Research Program to Be Expanded

By R. I. Throckmorton
Director
Kansas Agricultural Experiment Station

THE increase in research funds made available by the 1951 session of the Kansas legislature will make possible a major expansion in the wheat research program of Kansas. A much needed expansion in existing research projects and the addition of new projects will make possible a well rounded approach toward solving many of the wheat problems of the state. No one expects an immediate solution to some of the problems, but within a relatively short

R. I. Throckmorton

period of time, information should be available which will aid materially in reducing wheat losses.

In the past, the wheat research men have not had sufficient funds with which to employ research assistants and other personnel to handle the many details associated with the problems. Neither have they had sufficient funds to enable them to keep in as close contact with the problems in the field as has been desirable. Facilities have been inadequate for many types of studies.

The 1951 legislature provided $60,000 for a wheat mosaic greenhouse. It is anticipated that construction of this building will start in the fall of 1951. Because of the exacting requirements in working with wheat mosaic, the greenhouse will be of special construction and will have eight sections, each of which will have individual temperature and humidity control units.

Of the new funds provided for applied research, $10,500 will be used for wheat mosaic research. A man who is well trained in virus diseases of plants will be added to the staff. He will be provided with research assistants and a sufficient travel fund to enable him to keep in close contact with the development of the disease in the field. Fortunately, the U.S. Department of Agriculture has decided to continue Dr. Hurley Fellows at Kansas State College. Dr. Fellows is one of the best informed men in the country on wheat mosaic. He will work closely with the man to be added to the staff.

A part of the $10,500 for wheat mosaic studies will be used to study the relation of various insects and cultural practices on the development of the disease and to attempt to develop varieties having resistance to wheat mosaic.

The special wheat research appropriation of $75,000 annually will enable the Kansas Agricultural Experiment Station to materially strengthen the existing good wheat research programs by adding some much needed scientists and by providing research assistants, operating funds and facilities. The additional scientific staff will consist of two individuals in the general field of genetics or plant breeding to develop better varieties having more cold, drouth, insect and disease resistance than do existing varieties without sacrificing yielding capacity and quality. A scientist in entomology, who will be located at Garden City Branch Station, will be added. He will devote all of his time to the insect problems of southwest Kansas especially as they relate to wheat production. This man

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Best salesman for pancake mix

The best salesman for any pancake mix is the customer who buys it over and over and over again. Also, this adds up to the best way of increasing sales while decreasing sales costs.

Best way to get all this is to leaven your mix with Monsanto HT Monocalcium Phosphate. It adds these important improvements:

1. Better eating. Pancakes are more tender, more crisp, have better flavor.

2. Greater uniformity. First and last batch of cakes in each package are more nearly alike. No "letdown."

3. Longer shelf life. Premature reaction of the prepared mix is minimized, since Monsanto HT Monocalcium Phosphate is spray dried.

In addition, spray-dried Monsanto HT Monocalcium Phosphate is free-flowing and mixes easily with other ingredients. No alteration necessary in your present mixing equipment.

For detailed information on the uses of Monsanto HT Monocalcium Phosphate, contact the nearest Monsanto Sales Office, or write MONSANTO CHEMICAL COMPANY, Phosphate Division, 1700 S. Second Street, St. Louis 4, Missouri.

DISTRICT SALES OFFICES: Birmingham, Boston Charlotte, Chicago, Cincinnati, Cleveland Detroit, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Seattle. In Canada, Monsanto (Canada) Ltd., Montreal.

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MONSANTO

SERVING INDUSTRY... WHICH SERVES MANKIND

will be provided with transportation and facilities to enable him to keep in close contact with the growers of wheat in that territory.

In addition, research assistants will be employed to enable the technically trained personnel to be more efficient and thus increase their value.

Approximately $8,000 of the fund will be used this year to remodel one of the greenhouses and make it suitable for research in the field of the control or prevention of stem rust. A part of the fund will also be used to improve the equipment used in studying cold and drouth resistance. Some phases of soil research as related to wheat production will be strengthened as will some of the wheat quality research.

——BREAD IS THE STAFF OF LIFE——

ALLIS-CHALMERS ISSUES NEW BULLETIN ON MOTORS

MILWAUKEE — The advantages and limitations of Allis-Chalmers totally-enclosed motors with air-to-water heat exchangers are related in a new bulletin released by the company.

Properly fitted enclosures keep out dust, dirt, fumes and excess moisture, according to the bulletin. As a result, maintenance is reduced and machine life is lengthened.

The bulletin includes a description of the three types of cooler arrangement—foundation, side or top-mounting—built into the motors and explains how to estimate their water requirements.

It is pointed out that for each installation, the advantages of enclosed construction with air-coolers must be weighed against the following factors: cost of cooling water and the need for a continuous supply; cleaning required by sedimentation or scaling in water tubes; impracticality of outdoor operation in freezing climates.

Physical and manufacturing limitations must also be considered. Some motor ratings may have a peripheral speed too low for the rotor fans to overcome the pressure drop through the cooler and duct system. Such machines require the addition of motor-driven booster fans or blowers—usually mounted on the frame of the machine.

The bulletin also states that for smaller machines, especially in the general purpose range, manufacturing considerations make modifications for air-cooler construction impractical. Moreover, where small machines must be enclosed, the totally-enclosed fan-cooled type is more suitable economically and operationally. This is especially true of high-speed machines rated less than one horsepower per r.p.m.

Copies of the bulletin, "Allis-Chalmers Totally-Enclosed Motors with Air-to-Water Heat Exchangers," O5B7682, are available upon request from Allis-Chalmers Mfg. Co., 1102 S. 70th St., Milwaukee, Wis.

——BREAD IS THE STAFF OF LIFE——

How to make good foods better

FOR GRITS . . . FOR MEAL. Corn meal and grits have long been American favorites. Today you know that these fine foods have only small amounts of certain vitamins and other nutrients essential to human health. Moreover, degermed meal and grits unavoidably lose some of this essential nutritive value in milling. Now, by the simple, scientifically-proven means of enrichment you can restore important vitamins and minerals (or increase them in whole corn meal which is naturally low in niacin and iron). When you make your products better nutritionally you are "Making A Good Food Better"*, and you are helping to protect the health of a large number of the nation's people. Remember: better products have a better chance to sell better.

QUICK FACTS ABOUT ENRICHMENT

The requirements for various vitamins and minerals to meet Federal Standards of Identity for ENRICHED Corn Meal and Corn Grits are as follows. Figures represent milligrams per pound. Levels must not fall below 85% of minimum figures after a specific rinsing test described in the Federal Standards of Identity.

Thiamine (B_1)	2.0- 3.0
Riboflavin (B_2)	1.2- 1.8
Niacin	16.0-24.0
Iron	13.0-26.0

Calcium, 500 mg.–750 mg. per pound and vitamin D, 250 U.S.P. units—1,000 U.S.P. units per pound are permissible additions to enriched corn meal and grits.

* *The title of a color film on the enrichment of corn meal and grits produced by Clemson Agricultural College. This film is widely recognized as an outstanding educational film on food and nutrition and is being shown by many health departments and schools.*

VITAMIN DIVISION • HOFFMANN-LA ROCHE INC. • NUTLEY 10, N. J.

In Canada: Hoffmann-La Roche, Ltd., Montreal, Que.

ROCHE VITAMINS FOR ENRICHMENT

Keeping faith with nature

Storage Life of Long Extraction "National" Flour

Consequent upon the inclusion of the added amounts of germ in the flour, and also the added amounts of bran unavoidably contained in long extraction flours, there have been very considerable changes in the characteristics and qualities of the flour, not least of which in importance are the storage and keeping qualities.

Conclusions from many tests and experiments indicate that the moisture content has considerable bearing on these qualities. Previous to 1939, flours at a normal moisture content of 14% would retain their baking conditions for two years in a reasonable store and with some small amount of turning over. Mites or lumpiness were generally found to occur before the baking qualities were destroyed, suggesting that if flour was to be in store for long periods or where turning over was not possible, moisture content of below 14% might be advisable.

When National Flour was introduced in Great Britain, even at 14% moisture, the storage time, without spoiling baking quality, was reduced to about 9 to 12 months, and with an increase in moisture, to 15½%, it was reduced to as low as two months.

At high moisture contents the deterioration of flour proceeds more rapidly. This is mainly caused by changes in gluten quality brought about by the development of acidity, which is accelerated in long extraction flours by the increased quantity of oil from the germ, so that an optimum moisture content was placed as a result of experiments, at between 14 and 15%. This rancidity of the fat in the germ would also cause an unpleasant smell in the flour and a sourness to the taste.

Besides this chemical danger to stored flours, there is the possibility of some of the troubles which arise in the storage of bran entering into the case of high extraction flours where so much additional bran is included. The bacteria and mold spores associated with bran are introduced to the flour. The number of bacteria generally falls off rapidly in storage, but molds tend to develop when the moisture exceeds 14%, particularly if the store happens to be warm.—**Milling.**

Products Control
in the Feed Industry

★ ★ ★

By Dr. Max C. Markley

PRODUCTS control in the feed industry means making certain that your individual brands of feeds are uniform today, tomorrow and yesterday. Uniform in respect to chemical composition, uniform in respect to color, uniform in respect to granulation, uniform in palatability and uniform in relation to the price levels of the markets—these are the fundamentals of products control.

Products control is very highly developed in industries which involve chemical processes. If, for example, you are buying sulfuric acid, you specify a certain grade and you know what you get. I use chemically pure reagent acid, and it is sold under guarantee that it will contain a minimum of 95.5% acid and has less than .0001% of ammonia. It has been over 20 years since I have found a bottle of acid which did not meet these close specifications.

EDITOR'S NOTE: In the accompanying article, Dr. Markley cites the importance of products control in the manufacture of formula feeds, pointing out that "control means profit in the feed plant." He notes that when a processor operates without proper control, he may be unaware of heavy losses. And he explains how a control program can be profitable if the manufacturer makes effective use of chemists' findings and if there is close cooperation among all persons important to the control system. Dr. Markley is head of the Markley Laboratories, Minneapolis, and Lexington, Neb. The article is the principal text of an address by Dr. Markley at the Northwest Retail Feed Assn. convention.

In the feed trade we do not need such precise control, but a proper measure of control is essential if full profits are to be had. Just because you are making a profit is not to be certain you are making the maximum profit you should be getting. The hidden losses come where most operators fail to look for them, namely, in your bulk lower cost ingredients. The manufacturers of the high priced ingredients which are used in small quantities, such as vitamins, antibiotics and trace minerals, normally work under very close control and their products can be depended upon to be uniform. The testing of such ingredients is expensive, and frequently the methods are not as yet standardized between laboratories, so that results vary widely between chemists.

Major Tonnage Items

The place where control means dollars in the bank is on the major tonnage items. These are rarely as closely controlled as are the high priced ones. Too little attention is being given to the old factors of protein, fat, fiber, moisture, ash and nitrogen free extract. It is fashionable now to talk about vitamin B_{12} and antibiotics. A few years ago it was riboflavin and sulfa drugs. It will be something else next year probably.

The various processed meals, like soybean oil meal and alfalfa meal, which are sold to the feed manufacturer are commonly sold on minimum guarantees. For example, soybean oil meal of the expeller type is guaranteed 41% protein. Many lots of this meal may carry as much as 44%. If you get a 30-ton car of this higher protein meal and use it in a poultry or hog concentrate at the rate of 50% of the formula and you have calculated your formula on the basis of 41% protein, you will find your feed is about 1½% higher than you anticipated in protein.

If you had made a protein test on this car and corrected your formula, you would have substituted 100 lb. of lower cost filler for an equal weight of soybean oil meal in the formula. If the filler was only $20 ton cheaper than the soybean oil meal, you would still save $1 ton of concentrate. The dollar spent for a protein test on that

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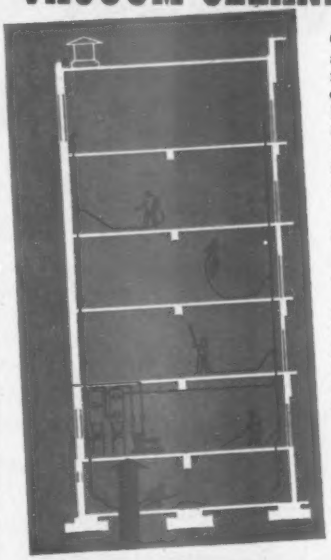

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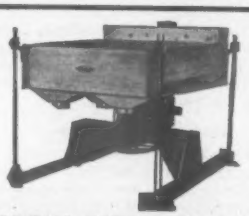

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car of soybean oil meal would have brought back $60 in return.

This may sound fantastic, but just recently we had a case settled on our analysis which returned the miller over 100 to 1. This was on a car of cracklings, or unground meat scraps, from a branch plant of one of the largest meat packers. This car was sold on a seller's laboratory test of 55% protein. The unloading sample at the buyer's plant was tested in our laboratory with a figure of 50.8% protein. Later tests of the ground product as prepared for sale to the feed trade showed that the lower figure was essentially correct. An adjustment of $8 a ton was made on the basis of our test. In this case the $3 test for protein fat and fiber brought a return of nearly $350 in adjustment. The manager of the grinding plant told me that this one adjustment will pay all laboratory costs for several months. He has another similar one in the process of adjustment.

When a processor operates without proper control he is frequently unaware of very heavy losses. Recently we have had three examples of rendering plant operators throwing away $500 a car for cracklings sold to the grinders. In these cases involving three plants in as many states, the residual fat content of the cracklings ran from 13 to 13.6%. Good plant operation would leave 8% grease in the cracklings. Actually these men left 2 tons of their high priced grease in each car of the cracklings. Cracklings are sold on the basis of about $2 a per cent of protein a ton, and as a result they got nothing for the excess grease in the cracklings. They had to pay the freight on this grease to Minneapolis. The net loss per car was over $500. These operators were watching the protein, as each car was within a fraction of 50% protein, but they were not paying attention to the even more important factor, namely, the residual fat.

Not all losses are as spectacular as the ones cited. Ordinarily they are not anyway near as great. However, control means profit in the feed plant. Let us take the lowest priced feed most of you make, namely, 16% protein screenings base dairy feed. The screenings normally used for this feed are light in test weight and fairly dark in color. They may range in protein from 10 to 22%, though usually from 14 to 18%. Bran is usually the second ingredient in this feed. Since there is no premium for protein in bran, the flour millers normally tag it 14% which is the lowest they are apt to produce. Spring wheat bran averages above 16% in most cases.

	Proportion	Protein	Prot. Ext.
	%	%	%
Molasses	10	4	0.4
Mineral	3	0	.0
Bran	10	14	1.4
Linseed oil meal	5	34	1.7
Soybean oil meal	10	41	4.1
Screenings	62	14	8.7
Protein content of feed			16.3

When ingredients were analyzed, the following showed the actual protein:

	%	%	%
Molasses	10	4	0.4
Mineral	3	0	.0
Bran	10	16	1.6
Linseed	5	36	1.8
Soybean	10	44	4.4
Screenings	62	17	10.6
Actual proteinn content of feed			18.8

A corrected formula of equal merit as a competitive dairy feed making use of the actual analyses could be:

	%	%	%
Molasses	10	4	0.4
Mineral	3	0	.0
Bran	10	16	1.6
Linseed oil meal	2.5	36	.9
Soybean oil meal	2.5	44	1.1
Screenings	72	17	12.2
Protein content of corrected feed			16.2

Then let the operator get solvent soybean oil meal and linseed oil meal with his higher proteins and see how this control works out.

A dairy feed made on screenings base with standard formula calculated from protein guarantees and minimum average proteins:

In the corrected formula 200 lb. screenings worth 1½¢ lb. were substituted for a like amount of oil meals worth 3½¢ lb., or an ingredient saving of $4 a ton, or $120 on a 30-ton car. The cost of making the protein tests would be slightly under $2 a car. The time in the office to calculate and type the new formula would not exceed 30 minutes, so an overhead charge of $1 is added to the control cost. In this example a control cost of $3 would give a return of $120, or a 40-to-1 return.

In higher priced high protein supplements there is also profit for testing. For example, in a hog or poultry supplement of, say, 37% protein in which the amount of 41% soybean oil meal would be 70%, the use of solvent meal with an actual test of 45% protein would result in the chance to substitute 10% of middlings for 10% soybean oil meal. At this writing this would make a saving of $2 a ton of concentrate made. The other nutritive factors in the formula are not changed. If, on the other hand, the formula is calculated on the basis of the higher protein and the purchasing agent gets a good buy on a lower protein grade, there has to be a corresponding upward shift in the formula. This shift may frequently nullify the potential savings of the lower price of the ingredient.

An example of this would be in an egg mash formula in which 25% of corn or oats can be interchangeable. Say the oats cost $60 and the corn $58 a ton ground, the oats tests 12% protein and the corn 8%. Now 500 lb. ground oats would cost $15 and would

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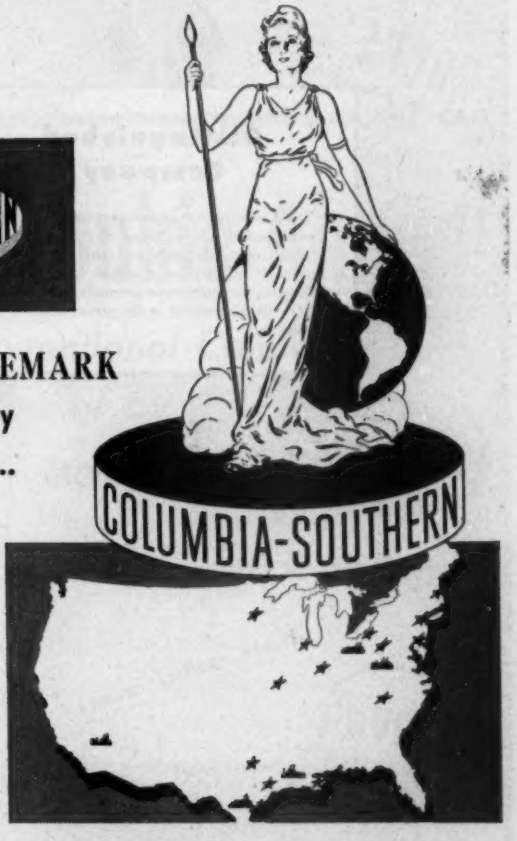

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furnish 60 lb. protein. The corn, though $2 a ton cheaper, is much lower in protein so it would take 440 lb. corn and 60 lb. soybean oil meal to replace the oats and the cost of using the cheaper corn would be $15.16, or a little higher than the oats.

Moisture is another variable in the feed mill. The flour miller and the oil crusher can control the moisture in their products because shifts in the moisture content of the raw materials is an integral part of the process. But in feed mixing the feed control officials frown heavily upon any attempt by the mixer to control the moisture content of his product. He is not allowed to compensate for moisture losses during the storage by the addition of an equivalent amount of water to his feeds.

His only control of the moisture losses during storage is by avoiding the storage of high moisture ingredients. The three ingredients which are most commonly found excessive in moisture are bran, soybean oil meal and blood meal. It is a good idea to test these for moisture before putting them into storage. High moisture lots can be handled in several ways, by immediate use, by price adjustment so as to avoid the loss or by rejection.

In the ordinary feed plant the crude fiber is of lesser importance. However, if the plant is buying its oats and barley ready ground, then fiber should be checked. The oat grinding business is so highly competitive that of a necessity the quality of the product very closely parallels the price. If you buy a first line product and pay the going price, you will get a product with light color and low fiber. If on the other hand, you try to get your ground oats as cheaply as you can, you will get more hulls and less groats in the grind. Feed mixers who have close control in their plants tend to buy better ground oats than do those who only look at the cost figures.

The place to exercise control is before the product is made. This means test the ingredients and make use of the tests. If you have the key analyses of your major ingredients, then you can take advantage of both the variations in analysis and in relative costs. Calculate your formulas on the basis of the ingredients now in your warehouse.

One ingredient which should be tested regularly upon receipt is alfalfa meal. While the producers are doing an ever better job of putting out a uniform product throughout the year, there is much variability yet to be overcome. Part of this is inherent in the meal itself. The quality of the green alfalfa is constantly varying throughout the growing season. The 100% dehydrated meal in a Platte Valley dehydrating plant will start at 25% protein and 200,000 carotene in the spring and drop to 15% protein and 100,000 carotene in the summer and then build up to very high quality late in the fall. If the early cut meal is stored until January it will normally be found to be down in carotene to 50,000. This normal drop has to be taken into account if alfalfa meal is purchased during the period of peak production and lowest prices in the early summer.

The better alfalfa dehydrators blend to a constant analysis during the entire year and deliver a reasonably uniform product. However, the meal should in all cases be tested for carotene content at the time of shipment. Usually the shipper will take a reliable sample and have it tested by an independent laboratory for you, if requested at the time of purchase of the car.

The small operator can at times take advantage of small lots of ingredients. For example, in this area there is a small rather intermittent production of carp meal of reasonably good quality. The tonnage is too low to interest the major mixers but is in line with the requirements of the local grinders.

The control program for any feed mixer is dependent upon the way in which he operates. The mixer who builds his feeds from the ground up and uses no prepared concentrates needs to have more testing of ingredients than the one who simply buys a concentrate and adds what the concentrate maker tells him to put in. The mixer who builds from the ground up needs a complete program, and he is in a position to make the most profitable use of the testing. He can take best advantage of competitive situations in the ingredient market.

There is no one best system of products control which will fit all plants. That is something which has to be worked out individually.

Remember, a laboratory report is just a scrap of paper until you put the information to work for you. The best chemist in the most modern laboratory can produce no profit by himself. It is up to you to make the profit out of the findings of the chemists. Far too many feed manufacturers, even some of the major operators, have no adequate control program. A show laboratory maintained for the benefit of the sales department and staffed by a photogenic but half-trained girl is not a control laboratory. A control system is the result of close cooperation between the general manager, the production superintendent and his shift foremen, the purchasing agent and the sales manager. If anyone fails to cooperate, then the control system is out of step and will not function.

Grain Storage

(Continued from page 3a)

highest percentage of wheat of 12 to 12.9% moisture content was stored.

The rate of increase of insect populations in grain of different moisture content during the first five months of farm storage is given in Fig. 8. Increases were most rapid in grain containing 12 to 14.9% of moisture. In grain of higher moisture insect populations were low, due largely to the presence of fermentation gases. Moisture is, therefore, an important factor in the rapidity with which insect populations increase in grain during storage on the farm.

Methods of Preventing Insect Damage

It is important that granaries or bins for farm-stored grain be as nearly insect-free and moisture-proof as possible and that all sources of infestation be eliminated. Small moisture leaks in bin walls cause spoilage of grain (Fig. 9) and create favorable places for the development of insects.

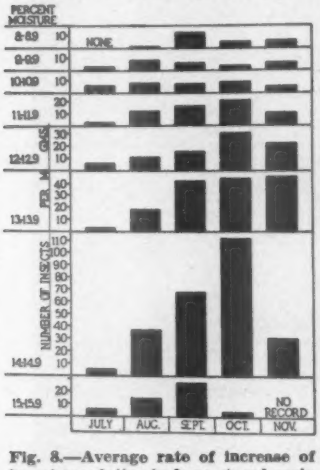

Fig. 8.—Average rate of increase of insect population in farm-stored grain of different moisture content during the first five months of storage. Reno County, Kansas, 1946-50.

Fig. 9.—Spoiled wheat clinging to the wall of a bin after it is emptied.

Stored-grain insects are strongly attracted to moist grain. When bins are emptied, they should be thoroughly cleaned to remove all the old grain from cracks in wooden walls and floors. Wooden bins, after they are cleaned and some time before they are refilled, should be treated with a residual spray at the rate of 2 gal. per 1,000 sq. ft. of wall area. Emulsions or water suspensions containing 2.5% by weight of DDT, TDE, methoxychlor or chlordane are satisfactory sprays. They will kill most of the insects that emerge from burrows and cracks in the wood and will greatly reduce the infestation in new grain that is put into the bins at harvest time.

If insects have already become established in the grain, they should be destroyed before they cause additional damage. Fumigation is usually the most satisfactory method of controlling such infestations.

Fumigation consists in building up a lethal concentration of toxic gas in the grain and maintaining it long enough to kill all stages of insects infesting it, including those species feeding within the kernels. For this purpose several compounds, usually liquids, are suitable. When applied to the grain, they vaporize rapidly, producing a heavier-than-air gas, which permeates the grain mass. Obviously, the tighter the storage structure, the less fumigant will be required to produce killing concentrations of the gas.

Owing to the great variation in size, shape and tightness of farm granaries, it is difficult to make a single, all-inclusive recommendation on dosages and methods of application of a fumigant. Actually each bin or granary presents its own problem. Fumigants and dosages that have proved to be satisfactory for use in wooden bins under all but the most severe conditions are given in Table 3. These

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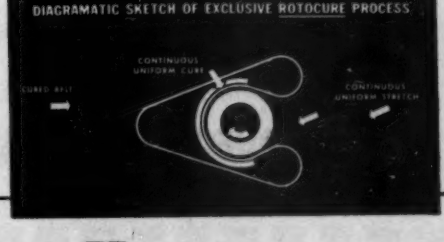

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dosages are based on requirements for grain of 12% moisture content or lower. For grain with more moisture dosages must be increased by one third. In steel bins the dosages may be reduced by one half for small grains and by one fifth for corn and sorghum grain.

If possible, fumigate when there is little or no wind. Before applying the fumigant, see that the surface of the grain is leveled; for best results it should be six inches below the top of the bin. If the surface is caked or crusted, stir it and remove any moldy grain.

Apply the fumigant as a coarse spray evenly over the surface of the grain. If severe infestation is known to exist near the edges, or elsewhere in the bin, apply a heavier dosage in such places.

Always apply the fumigant from the outside of the bin, and be careful to avoid inhaling the vapors or spilling the liquid fumigant on the skin or clothing.

For small operations a bucket pump or a garden sprayer is suitable. When using a garden sprayer, remove the spray nozzle and substitute one made of a six-inch pipe nipple with one flattened end.

For larger operations a power pump

Table 3—Fumigants and Dosages for Fumigation of Grain Stored in Wooden Farm Granaries

Fumigant—	Gallons, 1,000 bu. Small grains except sorgh. grain	sorgh. grain	Corn
Carbon tetrachloride	5	8	6
Carbon tetrachloride 80%, carbon disulfide 20%*	4	8	6
Carbon tetrachloride 25%, ethylene dichloride 75%*	6	10	6
Carbon tetrachloride 95%, ethylene dibromide 5%	3	8	6

*The addition of 5% (by volume) of ethylene dibromide materially improves the performance of this fumigant in killing insects in surface grain.

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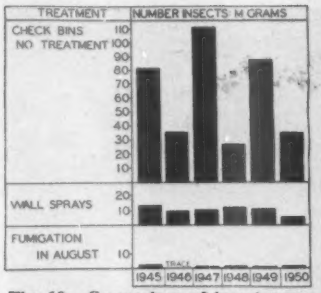

Fig. 10.—Comparison of insect populations in September in untreated farm-stored grain with those in bins receiving wall sprays or annual fumigations in August. Reno County, Kansas, 1945-50.

that will take fumigant directly from the barrel is desirable. All pump fittings should be bronze to resist the corrosive action of grain fumigants. Hose and gaskets should be of plastic or a synthetic rubber not affected by the fumigant.

In the South grain should be fumigated within two weeks after it is binned, and in most of the central portions of the country within six weeks. In the North fumigation may not be necessary, but it is a cheap insurance against losses from insects since severe infestations have occasionally been observed as far north as central North Dakota. In the central region one fumigation in mid-August will usually protect the grain until cool weather comes in the fall. However, the grain that is to be stored on the farm for more than one year should be fumigated annually between Aug. 15 and Sept. 15.

The investigation in Kansas has shown that farm-stored grain can be maintained practically free of insects. The peak of infestation is usually reached by mid-September, and any control measures should be applied before that time. The data from this work are shown graphically in Fig 10. Bins receiving no treatments were severely infested. Wall sprays applied while the bins were empty greatly reduced the infestation, and fumigation in mid-August almost eliminated it.

Too much emphasis cannot be placed on the need for preventing the establishment of insect infestations in farm-stored grain. The grower who waits until his grain is crawling with insects is inviting trouble. Preventing an infestation is much easier and less costly than attempting to control it after it has developed. In addition to the damage already done, heavily infested grain is difficult to fumigant successfully and many instances have been observed where grain has become unmanageable because of excessive infestation.

The question is frequently asked: "What is a dangerous insect infestation in farm-stored grain?" If living insects are found in the bulk grain, it should be watched carefully and if their numbers increase the grain should be fumigated. The presence of one or more weevils in a quart of grain is a dangerous infestation. A somewhat higher tolerance of bran beetles alone may be allowed, but in general the presence of any insects in stored grain should be looked upon with suspicion.

It is highly desirable that the moisture content of grain be determined when it is put into farm storage. This can be done at many line elevators, county offices of the Production and Marketing Administration or for a small fee at state grain inspection offices, and thus provide the producer with information on the susceptibility of his grain to insect attack.

The temperature of the grain is also a good index of its condition. If thermometers are not available, iron rods or pipes may be thrust vertically into the grain. They can be removed at intervals; if warm to the touch, the grain is heating. When hot spots are detected, the cause should be ascertained immediately by taking samples from the affected portions of the grain. This can be done by means of a grain trier or probe, if available—if not, by thrusting the arm into the grain and bringing up samples by hand if the hot spot is near the surface. The samples should be sifted through window screening into a shallow pan or other container. If live insects are found, the grain should be fumigated immediately. Otherwise some other cause of heating, such as high moisture, should be sought.

To summarize, the following program for the management of farm-stored grain is recommended:

BEFORE STORAGE

1. Clean bins thoroughly after emptying, especially all cracks.
2. Remove accumulations of waste grain or milled cereal products from underneath the bins, the driveways between bins, and from nearby buildings.
3. Make bins moisture- and rodent-proof, repairing all leaks.
4. Store bagged feed in a separate building.
5. Spray walls and floors of bins with a residual spray.
6. Store dry grain only (12% moisture or lower).

AFTER STORAGE

1. Inspect at least once a month,
2. Fumigate between Aug. 15 and Sept. 15, or within six weeks after putting the grain in the bins in the central region, or two weeks in the South.
3. Apply the recommended amount of fumigant as a coarse spray on the surface of the grain, and do it from the OUTSIDE OF THE BIN.

WATCHING THE BIRDIE—R. J. S. Carter of Minneapolis shot the above candid picture at the annual picnic staged for the active members of District 4, Association of Operative Millers by the allied trades representatives in Minnesota. The men in the picture are, from left to right: Hugh McDonald, Pillsbury Mills, Inc.; Donald S. Eber, executive secretary of the AOM; C. R. Veeck, Eagle Roller Mill Co., New Ulm, Minn., AOM president; Fred Lumsden, formerly with King Midas Flour Mills, Minneapolis; O. J. Zimmerman, General Mills, Inc., Minneapolis, and G. L. Smutny, Entoleter Division, Safety Car Heating & Lighting Co., Inc., New Haven, Conn. The men standing are Jack W. Perkins and A. P. Marschewski, both of General Mills, Minneapolis. The men are watching the marksmanship of their fellow picnic-goers during a trap-shoot.

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MILLERS' PICNIC—This picture was taken at the annual picnic staged for the active members of District 4, Association of Operative Millers, by the associate members in Minnesota. The picnic was held last month at St. Cloud, Minn. Included in the picture are Hill Shepardson and M. E. Cecka, Hart-Carter Co.; E. A. Anderson and Paul F. Olson, Pillsbury Mills, Inc.; W. R. Carter of the R. J. S. Carter Co.; A. B. Ward, Pillsbury Mills, Inc., and Kenneth McClelland, J. E. Rhoads & Son, Chicago.

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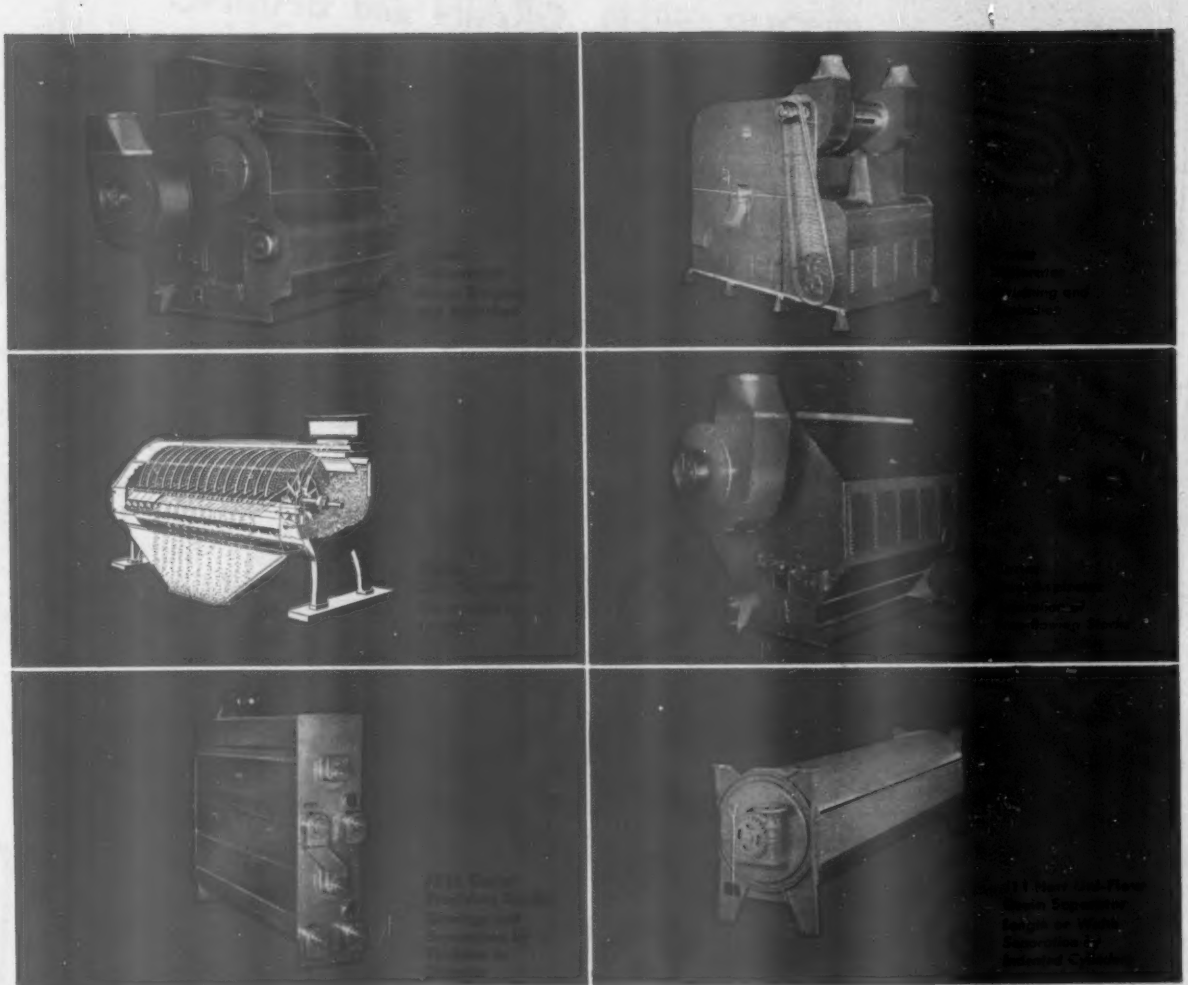

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